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**CATCH AND EFFORT AND SIZE DISTRIBUTION IN THE
IRISH LOBSTER AND LOBSTER/CRAWFISH FISHERIES.**

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Introduction

In recent years, increasing attention has been paid to the interpretation of the effects of fishing effort upon the stock abundance of commercially valuable decapod crustacea. Simpson (1970) has emphasised the value of and urgent need for, precise information concerning the effects of fishing effort on lobster and crawfish stocks.

By their very nature, lobsters and crawfish do not lend themselves particularly well to conformity with established methods of catch and effort analyses as applied to fish stocks. Therefore, whilst this almost traditional approach is adopted for lobster and crawfish studies, it may well be that considerable adjustments in the methodology are required if firmer estimations are to be achieved concerning the effects of fishing effort upon these animals.

A most important gap in our knowledge is that of the mechanism of recruitment. Without reliable estimates of annual recruitment it is difficult to interpret its effects on abundance of good or poor year classes. Fully reliable methods of ageing lobsters have not been perfected (See Table 5).

Recruitment and Population

It is not possible at this stage to provide satisfactory explanations of the means by which discrete stocks of lobsters are replenished. Gibson (1967) pointed to an annual influx of sub-legal (under 83 mm carapace length) lobsters to a fishery every October/November, during the period of investigation from 1958 to 1963. Presumably, the strength of these recruiting lobsters could be used as a means of determining the success of year classes, if exact information could be collected annually from sufficient boats, and a comparison made of their numerical strength over at least one decade. This would be valuable information, but it would not answer the more important questions dealing with the origin of recruits and the means by which they have joined particular individual stocks, during the period from larval life to adolescence.

Observations made in the Irish fisheries show that individual stocks of lobsters can be so reduced in strength as to become uneconomic to continued trapping. But traps are not highly efficient means of attracting lobsters and crawfish. Furthermore, they may not compete successfully with the natural food available and thus an uneconomic yield from a particular area which follows sustained heavy fishing, does not mean that all the adult lobsters or crawfish have been caught, nor is it known what proportion of the stock remains. On the other hand, these areas become repopulated in a relatively short time perhaps a year, rarely more than two years, by legal sized lobsters. The questions following this widespread and recurring phenomenon are many and include:-

- (i) Is the total numerical strength of individual lobster stocks much greater than the annual catch would suggest?
- (ii) How do territory conscious lobsters recognise that ground is unoccupied and what prompts them to make the migrations needed to accomplish repopulation?

How do such migrations agree with general tagging operations the results from which show such marked lack of migration?

- (iii) Does H. gammarus occupy a far more varied type of substrate than those rocky reefs which fishermen by tradition accept to be their habitat? (The work of Simpson 1961 and Dybern 1967, shows that H. gammarus may occupy a greater variety of substrate than might be expected).

- (iv) To what extent do unexploited stocks comprise the reservoir of larval production, of which the larvae, transported by water movement, replenish fished stocks? Will the exploitation of hitherto unfished stocks, upset the stock recruitment mechanism?

Table 1. Catch per boat per season and per month from 1951 to 1970

Year	No. of boats	Catch/boat/season			Catch/boat/month			Total catch lobsters and crawfish
		A Lobsters only	B Lobster and crawfish	Mean of A+B	C Lobsters only	D Lobsters and crawfish	Mean of C+D	
1951	634	405	461	433	108	124	116	333,522
1952	651	836	476	656	199	160	180	436,614
1953	739	628	466	547	160	111	136	435,386
1954	672	544	630	587	142	156	149	418,515
1955	383	1,380	2,428	1,904	350	344	347	570,990
1956	560	1,317	1,194	1,206	246	229	238	677,911
1957	544	1,152	1,108	1,130	282	227	260	643,283
1958	532	1,092	966	1,024	269	199	234	723,840
1959	558	2,179	1,000	1,589	369	175	272	894,707
1960	563	855	1,102	979	213	278	246	674,303
1961	526	680	856	768	180	226	203	453,373
1962	565	695	617	654	193	172	188	383,775
1963	531	683	622	653	196	178	187	354,548
1964	522	984	812	898	252	208	230	493,260
1965	565	864	1,130	997	211	276	244	526,250
1966	556	1,223	974	1,079	285	227	256	652,361
1967	640	1,125	648	887	263	151	207	624,670
1968	626	1,096	750	923	233	160	197	633,414
1969	671	1,053	784	919	182	135	159	660,769
1970	665	744	978	861	177	233	205	650,301

Table 2. Catch per 100 trap lifts from 1958 to 1970 for certain years only.

Year	Catch/100 trap lifts
1958	34
1959	33
1960	28
1964	34
1965	27
1968	22
1969	14
1970	15

Catch and Effort

One of the objects of this leaflet is to present such data as are available from Irish records of catch and effort. Relevant material on changes in the size distribution is given in the next section.

As may be the case elsewhere, there are mixed lobster/crawfish fisheries, separate lobster fisheries, but few wholly crawfish fisheries in Irish coastal waters. There was a specialised crawfish fishery off Co. Kerry in the late 1950s and early 1960s, but it was discontinued. During the winter/spring of 1970, 1971 and 1972, a very small specialised crawfish fishery has been pursued off the Wexford coast. Annual censa of the type and number of fishing boats, together with the length of the fishing season have allowed the data in Table 1 to be shown in terms of catch per boat per season, and catch per boat per month, in the case of separate lobster and lobster/crawfish fisheries from 1951 to 1970 (Table 1).

It can be seen that except for 1951, 1954, 1960, 1961 and 1965, the catch per boat per month was higher for craft fishing for lobsters only. This can be attributed to the extreme variability of the crawfish catch, caused not by the abundance of crawfish, but by the fact that there are so few boats engaged on crawfish fishing only. It seems likely that the crawfish fishery remains relatively underexploited, which is also the conclusion of Molloy (1970). The fluctuations in catch per boat per month for lobster fishing only, may, therefore, have more serious implications. In Table 1 the mean of the lobster only, and lobster/crawfish catches, compared with the total landings of both species are shown in the last two columns. Plotted against each other, these two sets of figures show a correlation at the 5% level ($r = 0.47$) which is not sufficient to confirm linearity. The reasons for this can only become known when sufficient catch per unit effort data have been collected. Catch per 100 trap lifts for certain areas have been collected for lobster fishing in 1958, 1959, 1960, 1964, 1965, 1968, 1969 and 1970. These are shown in Table 2. Since they apply to selected parts of the coast only, they may not reflect the national position. These figures, even though they arise from selected observations, could be significant if the drop in catch per effort which they indicate from 1964 to 1970, is a reasonable index of abundance.

It would appear, therefore, that the high catch per boat per season from 1955 to 1959, including years of good and bad fishing weather, is related to stock abundance over this period. From 1964 to date, the mean catch per boat per season has been 954, and the variation from that mean from + 145 to - 69. This persistent fishing yield is the result of more standardised fishing techniques and it suggests that little progress has been made towards exploiting hitherto unfished stocks. Furthermore, the new carapace size limit (83 mm) was introduced during this period. All these data have been collated in Fig. 1 in which the mean catch of lobsters/crawfish and lobsters only per boat per month from 1951 - 1970 have been plotted. The graph suggests that the period from 1955 to 1959 was one of high stock abundance followed by a sharp fall in yield during the early 1960s. The continued descent of the yield since 1966 is alarming, especially as the 1969 season was one of the longest (5.8 months) over the whole period. A recovery took place in 1970.

All the information so far suggests that with a few exceptions, the areas of coast fished remain unchanged from one year to the next. The majority of fishermen seem to be content to trap only those areas of coastal water where from past experience, lobsters are known to be present. In a small number of areas fishermen explore new fishing grounds continually and are able to rotate their fishing grounds annually. It may be significant that in these areas the catch per boat per season is well above the national average.

The earlier fishing effort data are approximate, due to lack of precise catch data. It is only during the last three years that it has been possible to make an annual trap census, and to collect as supplementary information, details of catch per 100 trap hauls from a relatively small, though growing, number of boats. The deposition of catch plotted against catch per effort given

in Fig. 1, is, therefore, based only on the crude data associated with annual number of boats \times length of season in months, and the total catch. Thus the points shown in Fig. 1 are scattered. However, one or two worthwhile observations may be postulated from the data. For example, a number of the points show a tendency to lie along the classical shape of a catch per effort distribution. But many lie well outside that curve and even if their position has been grossly exaggerated by the crudity of the basic data, nevertheless, the high yield per effort of 1955 must be compared with the low yield per effort of 1969. In both these years the total catch was about the same for lobsters, yet the catch per effort in 1955 was vastly greater than in 1969. Furthermore, Fig. 1 suggests that in traditional areas of fishing in Irish waters, the yield per effort has been dropping rapidly in recent years. How much of this has been due to overfishing or to the absence of strong recruit year classes is unknown, but the problems pose the most important questions for the management of lobster, and possibly, crawfish stocks as well.

Prior to 1940 the annual yield from the Irish lobster fishery remained at or above 1.25 million lbs per annum from 1895 to 1939. However, during this period, the fishery was entirely one for lobsters alone, and therefore only lobster fishing gear was in use. A greater number of traps were fished and, therefore, a larger area of sea-bed was searched. Thus it would appear that the only means by which a yield of this kind could be revived would be by extending considerably the area fished at present, using traps designed specifically for the capture of lobsters.

Size distribution of the Catch

Since 1957, lobsters have been examined for length distribution (except in 1961). The percentage frequency occurrence of male and female lobsters in the catch, for all coastal waters, in one cm carapace length groups (Table 3) have been used for the calculation of total mortality (Table 4). The calculated length for age in lobsters is given in Table 5.

Mortality estimates have been calculated, for males only, as percentage frequency loge distribution, and after Beverton and Holt, total mortality was estimated from the formula:-

$$Z = \frac{K (L^{\infty} - \bar{l})}{\bar{l} - l_c}$$

where \bar{l} is the mean length and l_c is the length at which lobsters appear to be fully exposed to capture ($L^{\infty} = 174.3$ and $K = 0.121$, Gibson, 1967).

Table 4. Estimates of mortality amongst male lobsters from 1957 to 1970.

<u>Year</u>	<u>Total mortality estimate (%)</u>
1957	73.3
1958	67.4
1959	61.0
1960	73.5
1961 ⁺	
1962	68.7
1963	55.8
1964	61.1
1965	62.8
1966	61.0
1967	73.6
1968	55.5
1969	65.8
1970	61.9

⁺no data available for 1961.

The independent and unmeasured variables exerting influence upon calculations of total mortality in the larger decapods are many. They include fishing limitations imposed on catch by the relative conservatism of fishermen some of whom tend to fish repeatedly in the same area; the absence of marked migrations by lobsters; the limitations imposed on fishing by the weather; and the unknown role played by recruitment.

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Table 3. Percentage frequency distribution of male and female lobsters in 10 mm groups for 1957 to 1969

Year	'57	'58	'59	'60	'61	'62	'63	'64	'65	'66	'67	'68	'69	'57	'58	'59	'60	'61	'62	'63	'64	'65	'66	'67	'68	'69
Size frequency of carapace (mm) distribution	Males													Females												
60 - 69	0.0	1.0	0.6	0.0	-	0.0	0.0	0.0	0.3	0.2	0.2	1.0	3.3	0.0	2.1	0.8	0.2	-	0.0	0.0	0.2	0.0	0.5	0.0	0.3	0.0
70 - 79	3.4	14.5	14.4	12.8	-	5.8	3.7	1.5	8.9	8.4	2.6	5.1	18.6	7.5	10.1	14.6	15.5	-	0.7	3.4	7.3	8.1	6.8	2.6	7.2	3.1
80 - 89	45.1	30.3	35.9	48.1	-	14.5	15.9	20.0	19.7	23.4	17.4	24.7	28.5	39.2	29.1	31.0	39.7	-	8.7	11.4	20.1	31.0	27.3	16.9	21.3	16.4
90 - 99	32.9	31.6	20.2	24.7	-	28.9	27.5	32.0	28.6	32.1	33.1	23.0	21.1	30.4	32.2	24.9	21.4	-	18.8	33.8	25.2	31.6	34.2	36.2	24.0	28.0
100 - 109	11.4	13.1	14.7	8.9	-	27.6	24.4	22.6	22.3	18.6	23.8	17.9	15.5	15.4	15.1	15.4	13.0	-	24.5	29.0	19.7	14.0	16.0	18.5	18.3	24.3
110 - 119	4.6	5.1	7.7	2.5	-	12.4	16.6	14.6	12.3	9.6	13.1	14.2	7.8	5.0	5.9	7.4	7.3	-	21.1	15.4	11.5	6.9	8.6	12.3	13.2	15.0
120 - 129	1.7	3.7	4.5	2.2	-	6.7	6.6	6.3	6.9	5.1	6.0	7.1	3.8	1.7	3.5	4.0	2.0	-	11.2	4.7	7.0	3.5	4.2	5.0	7.8	6.7
130 - 139	0.0	0.7	1.6	0.8	-	3.1	3.9	2.4	1.1	2.0	2.7	4.4	1.2	0.8	1.2	1.1	0.9	-	9.0	1.5	5.0	2.9	0.5	4.9	5.1	4.0
140 - 149	0.9	0.0	0.3	0.0	-	1.0	1.4	0.4	0.0	0.6	1.0	2.0	0.1	0.0	0.7	0.8	0.0	-	4.1	0.5	3.0	1.2	0.0	2.5	1.5	1.7
150 - 159	0.0	0.0	0.0	0.0	-	0.0	0.0	0.1	0.0	0.0	0.2	0.6	0.0	0.0	0.0	0.0	0.0	-	2.2	0.3	2.2	0.0	0.0	1.0	1.2	0.8

Table 5. Calculated length for age of lobsters, derived from tag releases and recaptures one year later.

Age in years.	Carapace length (mm).	Approx total length (mm).	Equivalent total length in inches.
1	11.9	56.9	2.2
2	37.6	122.7	4.8
3	53.2	162.6	6.4
4	67.0	197.9	7.8
5	79.3	229.4	9.0
6	89.7	256.0	10.0

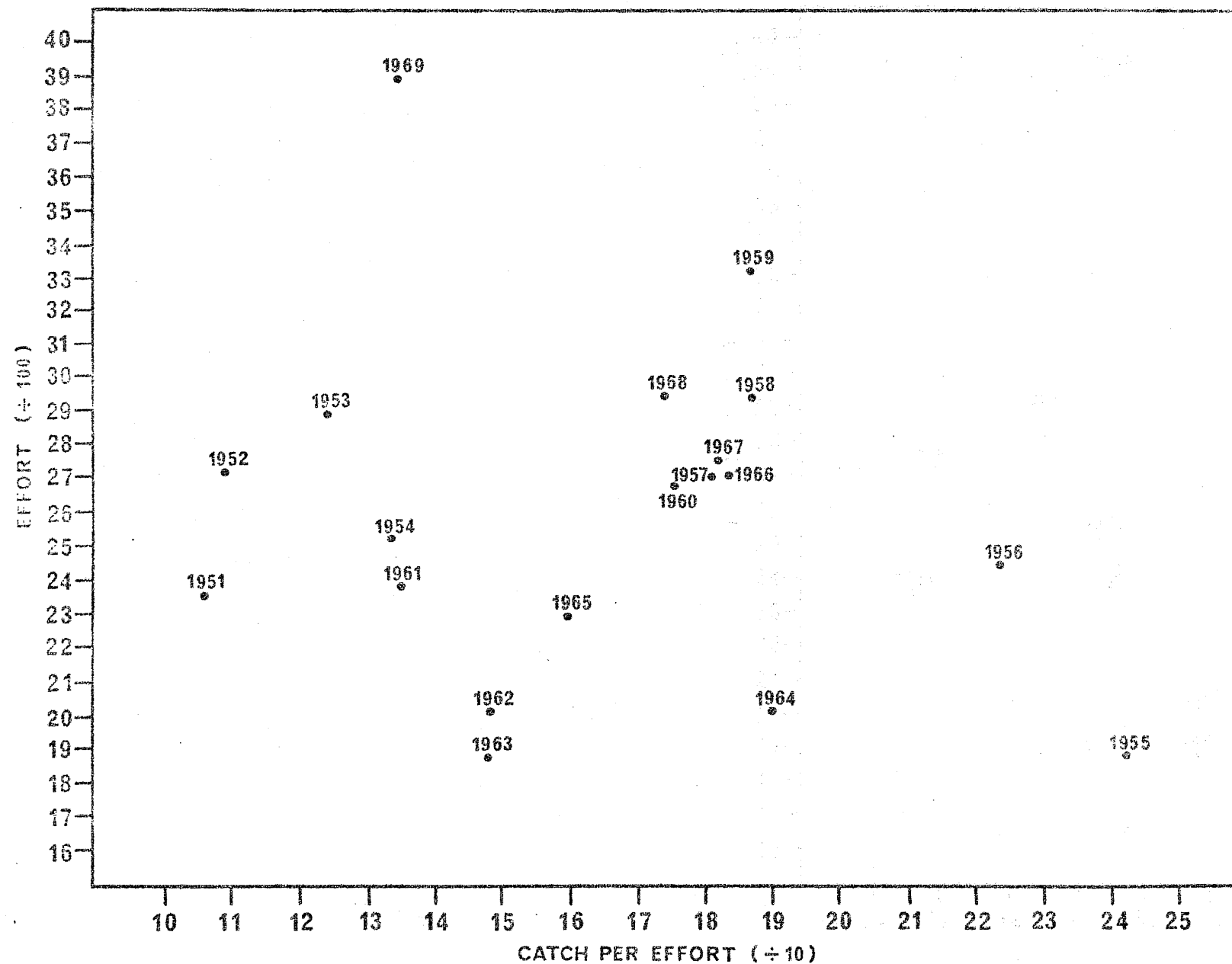


Fig.1. The catch per effort plotted against total effort in the Lobster fisheries from 1951 to 1969 (Effort being the number of boats x by the length of season, and the catch per effort being the catch per boat per month).